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The TOBACCO FLEA-BEETLE *in the* DARK FIRE-CURED TOBACCO DISTRICT

OF KENTUCKY & TENNESSEE

THE TOBACCO FLEA-BEETLE is second only in importance to the tobacco hornworms in the dark fire-cured tobacco district of Kentucky and Tennessee. On account of its small size and the insignificance of individual injuries its presence and ravages often pass unnoticed until considerable damage has resulted. Plant beds imperfectly protected by cheesecloth (commonly called "canvas") are sometimes entirely destroyed. In the field much of the transplanted crop may be either killed or badly stunted. Late-set crops suffer more severely than early-set crops, and the cumulative injury frequently reduces the value of the crop by many times the cost of applying remedial measures.

In this bulletin methods of control are recommended which will show a profit under the conditions for which they are advised:

Control of the tobacco flea-beetle in the southern cigar-wrapper district (northern Florida and southern Georgia) is discussed in Farmers' Bulletin 1352.

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THE TOBACCO FLEA-BEETLE[1] IN THE DARK FIRE-CURED TOBACCO DISTRICT OF KENTUCKY AND TENNESSEE.

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ECONOMIC IMPORTANCE.

THE TOBACCO FLEA-BEETLE (fig. 1) is one of the most injurious insects affecting tobacco and is found in all tobacco districts of the United States. In the more northern districts it occasions very little injury and is strictly a secondary pest, but in the more southern districts it is of prime importance and in the dark fire-cured tobacco district of Kentucky and Tennessee is a pest second only to the tobacco hornworms. Since the adult insect, or beetle, is only from one-fifteenth to one-twelfth of an inch in length, it often escapes notice until present in very injurious numbers. It injures the plant by eating small holes partly or entirely through the leaves (fig. 2) and owing to the nature of the injury the damage is not always so apparent as that of other and larger insects. No other insect attacking the tobacco plant feeds upon it from the day it appears above the ground until the crop is partially cured. No accurate estimate can be placed upon the damage caused by this pest, although it amounts to many thousands of dollars annually.

FIG. 1.—Adult tobacco flea-beetle. Twenty times natural size.

[1] *Epitrix parvula* Fab.; order Coleoptera, family Chrysomelidae.

COMMON NAMES AND HABITS.

The tobacco flea-beetle derives its name from its habit of jumping like a flea when disturbed. In some portions of its range it is also called the "tobacco flea," the "tobacco flea bug," or simply "flea bug." Many people are of the opinion that this insect is a true bug and derives its nourishment from sucking the juices of the tobacco plant. This belief is erroneous. It is a true beetle and obtains its food by biting off and eating portions of the leaves.

When disturbed the tobacco flea-beetle usually hops to some other portion of the plant or to the ground, although occasionally it may

FIG. 2.—Tobacco leaf in plant bed showing flea-beetles and typical injury. Enlarged 1½ times.

take wing. Flights with the breeze of as much as one-half mile have been recorded.

On the plant bed the beetles feed mainly on the upper surface of the leaves but in the field they feed mainly on the lower surface. Feeding continues after the tobacco has been hung in the barn and until the heat from the curing fires drives the beetles out or kills them. The beetles lay their eggs singly or in small clusters in crevices in the soil at or near the surface. The larvæ, or young, which hatch from the eggs, feed upon the rootlets of the tobacco plants that have furnished food for the parent beetles. Upon be-

coming full grown the larvæ enter the pupa stage—the stage of transformation to the adult—in cells in the ground near their place of feeding.

SEASONAL HISTORY.

This insect passes the winter in the adult or beetle stage under leaves and trash, in fence rows, around the edges of tobacco fields, or in adjoining woods. Emergence from hibernation begins late in March and may continue for more than a month. Egg laying begins early in May and may continue for as long as two months for the overwintered beetles. The first eggs deposited produce beetles in about two months; the beetles of the first generation therefore appear about July 1. The beetles of the second generation appear in August, and those of a third may appear late in September, although the second and third generations so overlap as to be practically indistinguishable.

FOOD PLANTS.

The beetle prefers tobacco as a food plant but it may feed upon many other plants. The common ground cherry [2] is the beetle's second choice of a food plant, and Jimson-weed,[3] a nightshade,[4] eggplant, and tomato are the other preferences in about the order named. Other plants of the potato family are fed upon to a lesser degree.

Under adverse conditions this beetle has been known to exist upon the leaves of various trees. The common chickweed [5] is an important food plant of this insect, and wild mustard,[6] pokeweed,[7] and cowpeas are fed upon freely at certain seasons of the year.

PLANT-BED INJURY.

Injury in the plant beds usually begins around the margins as soon as the young plants appear and often spreads over the entire bed, increasing in severity as the emergence nears its maximum. The month of April is the period of greatest plant-bed injury. During unseasonably cool weather feeding may continue uninterruptedly throughout the month. On the other hand, a few exceptionally warm days will so increase the temperature beneath the cheesecloth that the beetles will be driven out and injury may cease, temporarily. Should the warm weather continue, no further beetle damage will occur. A return of cool weather, however, is very likely to bring about a return of the beetles and a resumption of feeding and injury.

Under conditions favorable for maximum beetle damage plant beds may be, and often are, entirely destroyed, thus necessitating reseeding. Reseeded beds always produce late plants and a late-set crop, which is more subject to insect injury than earlier set crops.

When the injury is lighter it is usually confined to the margins of the bed and to areas beneath holes in the cheesecloth. The injured plants are always stunted and are rarely large enough to use in the first settings.

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[2] *Physalis virginiana* Mill.
[3] *Datura stramonium* L.
[4] *Solanum nigrum* L.
[5] *Alsine media* L.
[6] *Sinapis arvensis* L.
[7] *Phytolacca americana* L.

FIELD INJURY.

The next injury occurs shortly after the tobacco has been set in the field. The beetles are particularly fond of a wilted leaf touching the ground, and while the crop is becoming established they may concentrate upon the newly-set plants in such numbers as to destroy them. Lesser injuries often continue after the plants start growing and cause them to be much stunted. The larvæ of the tobacco flea-beetle are reared mostly upon the tender rootlets of the tobacco plants and this damage, though considerable, is not so apparent as the injury to the visible portion of the plant by the adult beetles. Replants to take the place of those injured or killed by flea-beetles are usually slower in growth and fail to mature, or "ripen," with the remainder of the field, which is a further loss in addition to the cost of replanting.

It is, however, during the later stages of the plant's growth that the really severe flea-beetle injury occurs. This is particularly true

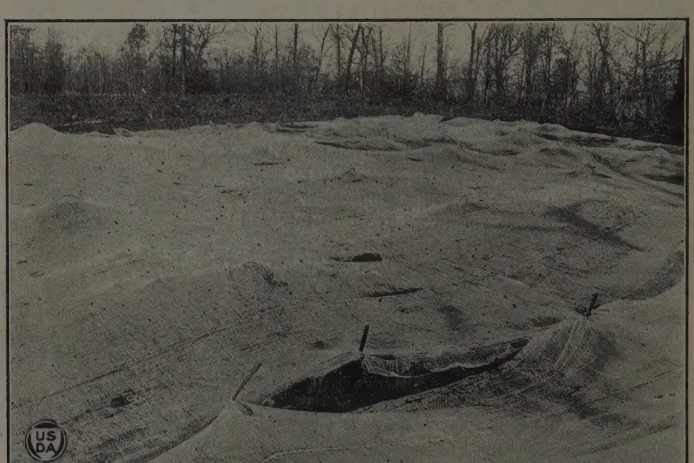

FIG. 3.—Tobacco plant bed improperly covered with cheesecloth.

when the tobacco is about half grown. Late crops also suffer more from beetle damage than do the earlier plantings. The beetles have then multiplied and searched out the younger and more succulent tobacco plants. Replants are especially liable to beetle injury at this time. Earlier in the season a plant attacked and injured or killed by flea-beetles can be replaced with some degree of success, but a plant half grown or larger represents a considerable monetary investment and can not be replaced by replanting. Damage done to a plant at this stage is therefore permanent. The feeding punctures of the beetle render the leaf of poor quality, reduce the weight, and considerably reduce the price when the tobacco is placed upon the market. It is here that severe monetary loss appears; how much, no one knows accurately, since most of the tobacco grown in the dark fire-cured belt always has a certain amount of flea-beetle injury. Ex-

ceptional infestations averaging more than 100 beetles per plant have been recorded. Such an infestation would soon render the plant of little value. Infestations of 50 to 75 beetles per plant are not uncommon, while many fields may be found with an average of 20 to 30 per plant. Any of these degrees of infestation will occasion considerable loss if remedial measures are not promptly employed. Hardly a field of topped tobacco can be found that does not have an average of 5 to 10 beetles per plant. Although feeding is confined chiefly to the lower and least valuable leaves, yet in the severer infestations considerable damage may result to the middle and upper, and higher-priced leaves and particularly to that small percentage of leaves which fall into the high-priced wrapper class.

LOCATION AND PROTECTION OF THE PLANT BED.

Plant beds located near a wooded area or other favorable hibernating quarters invariably show much more flea-beetle injury than

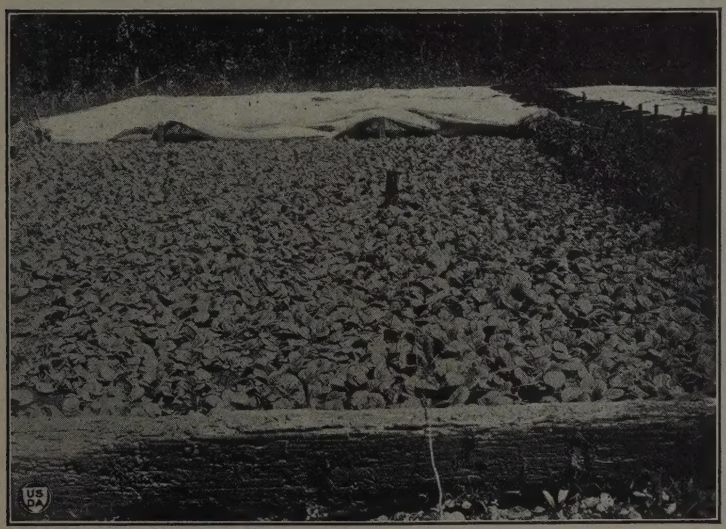

FIG. 4.—Typical stand of tobacco plants in a plant bed properly covered with cheesecloth.

beds located some distance from such sources of infestation. It is advisable, therefore, where practicable, to locate beds as far as possible from such sources of beetle supply.

The first operation in the preparation of a plant bed is the thorough burning or steaming of the soil in the space provided for the bed. This kills all flea-beetles hibernating in the leaves or trash in the treated area but must not be relied upon to prevent later flea-beetle injury. The next operation is the placing of boards or poles around the margins of the bed to support the cheesecloth with which all plant beds are covered immediately after sowing, and carefully banking soil around these boards or poles to prevent entrance of the beetles. The cheesecloth covering shown on the title page serves a

dual purpose. It tends to maintain more even conditions of temperature and moisture and also to protect the bed from the entrance and consequent ravages of insects. Only cheesecloth of good quality should be used, the mesh being small enough to prevent beetles from passing through it. Cheesecloth having about 25 strands to the inch is the right grade. Old and worn cheesecloth, even when carefully stretched, will soon tear and become full of holes (fig. 3) through which flea-beetles may gain unrestricted access to the bed from surrounding hibernating quarters. After the bed has been sown, extreme care should be taken to tack the cheesecloth to the poles so that there will be no openings for the admittance of beetles.

Where the bed has been properly prepared, as shown on the title page, by banking the earth up around the margins and by covering

FIG. 5.—Typical stand of tobacco plants in a plant bed improperly covered with cheesecloth.

it with sound, well-sewed cheesecloth, closely and securely fastened to the margin poles, little or no flea-beetle damage will occur. In addition, a bed well protected by cheesecloth has fewer weeds and a more uniform stand of plants. (See figs. 4 and 5.)

CONTROL OF THE FLEA-BEETLE IN THE PLANT BED.

Few farmers recognize that most plant-bed injuries and injuries to late and half-grown tobacco are caused by the same insect—the tobacco flea-beetle. The usual diagnosis made when a plant bed shows some flea-beetle injury is that the damage was done by the black flies seen under the canvas when the edge of it is raised. This is impossible, for these black flies are sucking insects and *do not feed upon the tobacco plant.*

As previously stated, if an infestation of the plant bed is noted, the injury is usually seen first about the outer edges of the bed. An excellent remedy is to apply a mixture of 1 part of Paris green with 5 parts of arsenate of lead at the rate of one-half pound per 100 square yards of plant bed. This poison will not burn or injure the plants in any manner and is effective in controlling the beetles. Usually one application will be sufficient, unless a rain falls a short time after the treatment, in which case the application must be repeated. The poison may be applied with a crank duster or bellows duster, or may be shaken through a cheesecloth bag. Care should be taken to prevent a spotty application since large deposits of this poison might burn where too heavily applied. Furthermore, excessive dosages are wasteful.

Very often with the crank duster good applications may be made without removing the cheesecloth, but the tobacco plants should be examined to be certain of this. Figures 6 and 7 show methods of applying poison to plant beds.

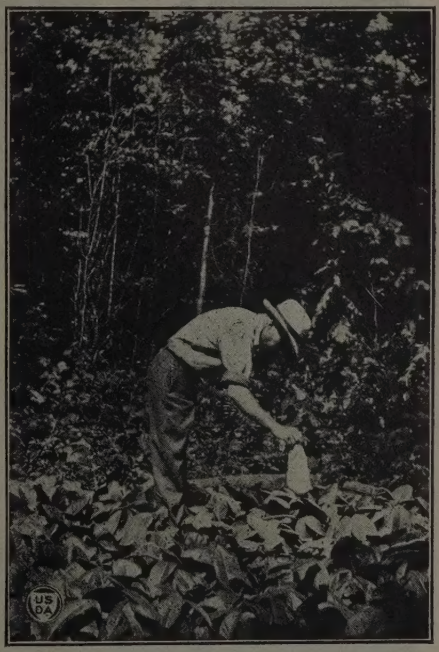

FIG. 6.—Dusting tobacco plant bed with cheesecloth bag.

Both Paris green and arsenate of lead will kill the flea-beetles that infest these materials, but it has been shown, as the result of numerous experiments, that arsenate of lead repels the beetles to a considerable extent. Paris green is fed upon much more readily than is arsenate of lead and has proved to be an excellent flea-beetle remedy. The combination protects plants better than either used singly. The arsenate of lead acts as a sticker, a repellent, and an insecticide, and is particularly advised for plant beds in which the cheesecloth must be removed to allow the most thorough application, and for field applications where the tobacco hornworms must also be controlled.

CONTROL ON NEWLY SET PLANTS.

A number of farm practices are in use in the dark fire-cured tobacco district which are of considerable value in controlling the flea-beetles on newly set tobacco. The more important methods are the use of (1) the "stick can," (2) the cheesecloth bag, and (3) the crank duster. These methods are somewhat wasteful of poison.

especially the one last mentioned. The "stick can" consists of a quart cup with nail holes in the bottom, fastened to a stick, and

FIG. 7.—Dusting tobacco plant bed with crank duster.

the poison mixture is sifted upon each plant as the operator walks between the rows. The usual formula for this method is 1 pound

FIG. 8.—Dusting newly set tobacco plants with the stick can.

of Paris green mixed with 20 to 40 pounds of flour, about 5 pounds of the mixture being applied per acre. A type of bellows duster

is on the market which is excellent for applying small quantities to individual plants and its use is the least wasteful of the four methods suggested. One puff is given to a plant and but little poison is lost in going from one plant to the next, which is not true with the crank duster which delivers poison continuously. It is necessary to add a diluent (flour) only when applying poison with the "stick can." For the other methods of application use the "one-in-six" mixture (1 pound of Paris green to 5 pounds of arsenate of lead) at the rate of 3 pounds per acre.

Two of the methods of applying poison to newly set plants mentioned above are shown in Figures 8 and 9.

An additional method of control for newly set plants is to dust the plant bed, prior to pulling the plants, with the one in six mixture

FIG. 9.—Dusting newly set tobacco plants with the Kentucky duster.

of Paris green and arsenate of lead. Use 1 pound of the mixture to 100 square yards of bed. If it is more convenient to spray than to dust the bed, use 1½ to 2 pounds of the foregoing mixture in 50 gallons of water. Pull the plants at once or as soon as dry, and set. Enough of the poison should adhere to these plants to enable them to withstand or at least to minimize flea-beetle injury. Unfortunately for this plan of control, rains are usually frequent at setting time and much of this pre-pulling poison application may be washed off. Rains, however, would interfere with any of the three previously-mentioned methods.

FIELD CONTROL.

Later in the season when the tobacco is topped, flea-beetles often become numerous and the tobacco may be seriously damaged. This

is especially true of late tobacco. An average of 5 to 10 beetles per plant suggests that control measures may soon be necessary, for this small number may be quickly augmented to 25 to 50 per plant.

FIG. 10.—Dusting half-grown tobacco with the crank duster.

At present the most successful method of control is to poison the field tobacco infested with flea-beetles with an application consisting of 1 pound of Paris green to 5 pounds of arsenate of lead, using

FIG. 11.—Dusting full-grown tobacco with a 2-row mule-drawn duster.

from 4 to 6 pounds of the mixture per acre. An even application is an absolute necessity if noticeable results are to be obtained. This amount of Paris green ($\frac{3}{4}$ pound to 1 pound per acre) should not

injure the tobacco in the least. The arsenate of lead when evenly applied should not " spot " the leaves and the mixture of Paris green and arsenate of lead offers a wonderful measure of flea-beetle control.

Another result of prime importance in the use of the foregoing mixture at the rate specified is that it is equally efficient as a hornworm insecticide.

Mention should be made of the types of apparatus available for the application of the flea-beetle insecticide to large tobacco. Crank dusters (fig. 10) are now on the market which can be operated efficiently by the tobacco grower of small acreage. For the grower having 25 acres or more there is the choice between the saddle-back duster and the 2-row mule-drawn duster (fig. 11). Any of the three types operate successfully in the dark fire-cured type of tobacco, the size of the crop being the determining factor.

SUMMARY OF CONTROL MEASURES FOR THE TOBACCO FLEA-BEETLE.

Locate the plant beds as far as practicable from the flea-beetle hibernating quarters. Sow the seed early, bank the earth about the boundary poles, and use sound cheesecloth properly applied.

Poison the bed if flea-beetles appear, using the " one-in-six " mixture (1 pound of Paris green with 5 pounds of arsenate of lead) at the rate of one-half pound per 100 square yards.

Before pulling the plants dust at the rate of 1 pound of the mixture to 100 square yards of plant bed. If a liquid spray is preferred use from 1½ to 2 pounds of the mixture in 50 gallons of water.

For newly set plants use about 3 pounds per acre of the one-in-six mixture in all methods of application, except the " stick can." With the " stick can " the formula should be 1 pound of Paris green in from 20 to 40 pounds of flour, about 5 pounds of this mixture being applied per acre.

For field control on tobacco half grown or larger, use from 4 to 6 pounds per acre of the one-in-six mixture. This will control the hornworms or tobacco worms as well.

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